Legacy Material Analysis with the LBNL Neutron Facility*

G.A. English‡, R.B. Firestone‡, D.L. Perry‡, J.P. Reijonen‡, F. Gicquel‡, K.N. Leung‡, B. Bandong†, G. Garabedian†, G. Molnar§, L. Szentmiklosi§ and Zs. Revay§

Analysis of legacy materials resulting from decades of research in DOE and other laboratories remains an important problem. Before these materials can be properly disposed of, they must first be characterized in order to minimize the volume of waste and ensure the safety of the handlers. The high-flux LBNL D+D neutron generator offers the prospect of on-site, high quality, nondestructive PGAA and NAA analysis of legacy materials without the limitations imposed at reactors.

To test the utility of the LBNL PGAA/NAA system to assay a target sample by short-lived NAA, an LBNL legacy item with an unknown history (i.e., no extant historical records) was selected to provide the analyses required for waste disposal (i.e., full sample characterization). The item that was selected for short-lived NAA had been radioactively 'contaminated' with ^{108m}Ag and ^{113m}Cd, the presence of which was determined by ordinary gamma spectrometry. It was a 'sandwich' type material consisting of an inner metal surrounded by a dull gray outer metallic wrap. The sample was placed inside the irradiation compartment of the PGAA/NAA system with polyethylene moderator placed between the sample and the neutron generator. The item was irradiated for ≈30 minutes at a neutron flux of $\approx 10^5$ n/cm^{2}s. Afterwards, the sample was removed from the irradiation chamber within ≈1 minute after shutting down the neutron generator and gamma-counted on the LBNL PGAA HPGe system for ≈15 minutes.

Figure 1 provides the results of the PGAA/NAA experiment. The 833.0 (0.2%) AND 1039.35 keV (7.4%) gamma rays from ^{66}Cu ($t_{1/2}$=5.088 m), the activation product of ^{65}Cu, are clearly visible in the spectrum, thereby confirming Cu as one of the metallic components.

With respect to the outer 'sandwich' metal, no activation product was observed. A separate, post-irradiation, gamma analysis was performed and the Pb K x-ray quartet was observed, the presence of which was clearly due to (radioactive) particle/γ-induced x-ray fluorescence. Since no prompt gamma line was detected during the irradiation, this observation clearly confirmed Pb as the unknown 'sandwich' metal since Pb has a low PGAA sensitivity. With these results, the item was classified as 'mixed waste' for waste-disposal purposes

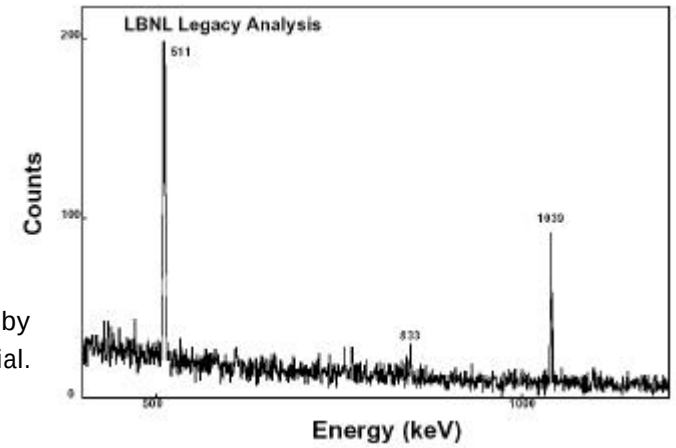

Figure 1. Spectrum of ^{66}Cu(5.088 m) produced by neutron activation analysis of legacy material.

Footnotes and References

‡ Lawrence Berkeley National Laboratory

§ Institute for Isotopes and Surface Chemistry, Budapest Hungary

† Lawrence Livermore National Laboratory